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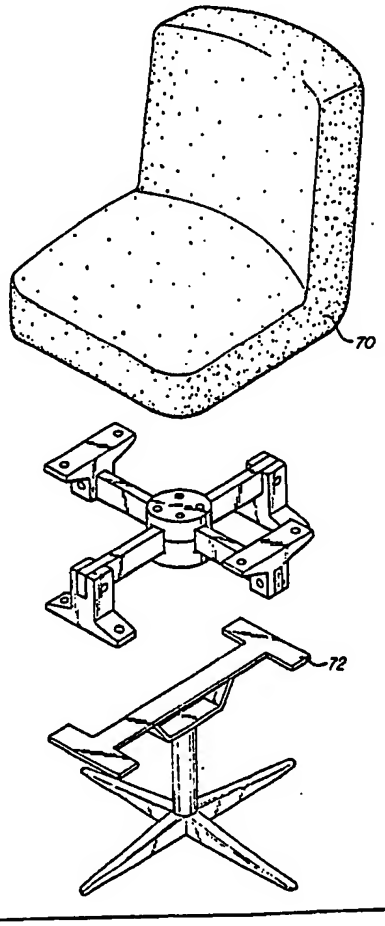
(54) Title: UNIVERSAL MECHANICAL LINKAGE

(57) Abstract

A universal joint suspension element has four torsion arms (32, 34, 36, 38), extending from a central location (40), forming a substantially planar member. Clamping means (42, 44) with a plurality of grooves (50, 52, 54, 56) fasten the member. The grooves are patterned such that the torsion arms are secured therein, with the grooves flared (59) near the periphery (60) of the clamping means (42, 44).



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Description

Universal Mechanical Linkage

Technical Field

The present invention relates to a universal joint suspension element and more particularly to a universal mechanical linkage for connection between a first movable body, such as a seat portion of a chair, and a second movable body, such as a support column or base portion of a chair.

Universal joints are well known in the art. In general, a universal joint is a shaft coupling which is capable of transmitting rotational movement from one shaft to another not colinear with it. The joint typically comprises a planar member having four rfgid arms extending from a central point (commonly called a spider), wherein the arms form a pattern of two lineal bars which are substantially perpendicular to one another. The ends of the two rigid arms that form one of said lineal bars are connected by bearings to a U-shaped element which is adapted to be connected to one of the rotational shafts. The other two ends of the other two rigid arms that form the second lineal bar are also connected by bearings to a second U-shaped element which is driven by a second rotational shaft. Thus, the rotational coupling from one shaft to another not colinear with it is achieved.

U.S. Patent No. 3,512,419 discloses another form of universal joint suspension element for use in free-rotor displacement type gyros. That patent teaches the use of torsion arms that can flex and twist instead of rigid arms. Nowever, that patent discloses a universal joint having only two degrees of freedom. Moreover, as disclosed in that patent as a desired

characteristic, the element has the characteristic of high angular compliance and extreme rigidity.

The use of a mechanical linkage in a system whereby two mutually movable members are present, such as a seat portion and a base portion of a chair, is disclosed in U.S. Patent No. 4,185,803. That patent, however, teaches the use of concentric rings and torsion bars. The use of such rings unduly complicates the system and adds to the cost thereof.

Disclosure of Invention

Therefore, in accordance with the present invention, a universal joint suspension element has a substantially planar member which has four torsion arms extending from a central location whereby the arms form a pattern of two lineal bars intersecting one another. Means are provided, securely fastening the arms at the central location. The means is characterized by a flared portion in the periphery of said means near where said arms extend from said means.

The present invention also provides for the use of said universal joint for connection between a first movable body, such as the base portion of a chair, and a second movable body, such as the seat portion of a chair.

Brief Description of Drawings

Figure 1 is a perspective view of a universal joint of the prior art.

Figure 2 is a top view of the unfversal joint of the present invention.

Figure 3 is cross-sectional view of the universal joint of the present invention taken along the lines 3-3.

Figure 4 is a cross-sectional view of a portion of the universal joint of the present invention taken along the lines 4-4.

Figure 5 is an exploded perspective view of a portion of the universal joint of the present invention, showing the construction of that portion thereof.

Figure 6 is a perspective view of the universal joint of the present invention showing its three degrees of freedom.

Figure 7 is a perspective view of another embodiment of the present invention.

Figure 8 is a top view of the embodiment of Figure 7.

Figure 9 is a perspective view of yet another embodiment of the present invention.

Figure 10 is a side view of the embodiment of Figure 9.

Figure 11 is a schematic view of still another embodiment of the present invention.

Figure 12 is a schematic view of still yet another embodiment of the present invention.

Figure 13 is an exploded perspective view of the use of the universal joint of the present invention in a chair.

Best Mode for Carrying Out the Invention

Referring to Figure 1, there is shown a universal joint 10 of the prior art. The universal joint 10 of the prior art comprises a first rigid arm 12, a second rigid arm 14, a third rigid arm 16, and a fourth rigid arm 18, all extending from a central location. The arms 12, 14, 16, and 18 form a pattern of two lineal bars that are substantially perpendicular to one another. One bar is formed by joining the first rigid arm 12 with the third rigid arm 18. A second Dar is formed by joining the second rigid arm 14 with the

fourth rigid arm 16. The ends of the first bar, formed by the first and third rigid arms 12 and 18 respectively, are connected by bearings to a first U-shaped element 22. The first U-shaped element 22 is connected to a first shaft 24. The ends of the second bar formed by the joining of the second and fourth rigid arms 14 and 16 respectively, are connected also by bearings to a second U-shaped element 20. The second U-shaped element 20 is connected to a second shaft 26.

Referring to Figure 2, there is shown a universal joint 30 of the present invention. The universal joint 30 comprises a first torsion arm 32, a second torsion arm 34, a third torsion arm 36, and a fourth torsion arm 38 all extending from a central location 40. The first, second, third, and fourth torsion arms 32, 34, 36, and 38 respectively, form a pattern of two lineal bars that are substantially perpendicular to one another. As will be shown hereinafter, the first and third torsion arms 32 and 36 respectively, may be of unitary construction, while the second and fourth torsion arms 34 and 38 may be of a second unitary member. Each of the torsion arms 32, 34, 36 and 38 is of the same size and shape and is substantially in the shape of a rectangular solid. However, as will be shown hereinafter, the shape or the size of the torsion arms 32, 34, 36 or 38 may vary and will still be within the scope of this invention. The four torsion arms form a substantially planar member. A pair of central clamps 42 and 44, with one of said clamps on each side of the plane formed by the torsion arms, securely fasten the torsion arms between the central clamps. Each of the central clamps 42 and 44 is identical in size and shape and is substantially cylindrically shaped. Each of the central clamps is immediately adjacent the other with the intersection of the torsion arms, i.e., central location 40 therebetween.

Referring to Figure 4, there is shown a cross-sectional view of the central clamp 42. The central clamp 42 is characterized by a surface 46, which is substantially flat, having four grooves therein, the first groove 50, second groove 52, third groove 54 and fourth groove 56. The grooves 50, 52, 54, and 56 also extend from a central location 58 to the periphery 60 of the clamp 42. The grooves are patterned such that the torsion arms 32, 34, 36 and 38 are secured in the grooves 50, 52, 54, and 56 respectively. Each of the grooves is flared outward 59 near the periphery 60 of the clamp. Four screws fasten the clamps 42 and 44 with the torsion arms therebetween. At the end of each torsion arm 32, 34, 36 and 38, there is a bridge 62, 64, 66, and 68 respectively. The first bridge 62 and the third bridge 66 are designed to be connected to a first movable body (not shown). The second and fourth bridges 64 and 68 respectively are designed to be connected to a second movable body (not shown). In this manner, the universal joint 30 may be connected between a first movable body and a second movable body.

Referring to Figure 5, there is shown a pair of rectangular springs. Each of the rectangular springs is notched in the middle, so that when the springs are assembled, all four edges of the spring are coplanar. In this manner, the four torsion arms of the universal joint 30 may be constructed. While the universal joint 30 has been described as having torsion arms that are substantially rectangular solid in shape, it should be clear that the torsion arms need not be so limited in the size or shape. In particular, the torsion arms may be cylindrically shaped, or square, or even tubularly shaped.

There are many advantages of the universal joint of the present invention. First, unlike the

universal joint as disclosed in U.S. Patent No. 3,512,419, which has only two degrees of freedom, the universal joint 30 of the present invention has three degrees of freedom. As can be seen in Figure 6, the universal joint 30 of the present invention may be rotated about the axes 100, 102, and 104. In contrast, the universal joint, as disclosed in U.S. Patent No. 3,512,419, has rotational freedom only about the axes 100 and 102. Secondly, the spring rate of the universal joint 30 of the present invention may be varied by varying the size of the central clamp 42 and 44. In general, the spring rate of the joint 30 is determined by the characteristic of the material used, the free length, the free width and the free thickness. In the universal joint 30 of the present fnvention, once the torsion arms have been chosen, the material is set, the width is determined, and the thickness cannot be changed. The free length, however, is the distance L between the periphery 60 of the central clamp 42 and the bridge which connects the universal clamp to the movable body. By varying the size of the central clamp, the free length L may be varied. Thus, the spring rate of the universal joint 30 of the present invention may be varied with considerable ease by simply changing the size of the central clamp 42 or 44. Thirdly, because the grooves of the central clamp are flared near the periphery of the central clamp, this assures that there are no sharp stress concentration points where the torsion arms must flex or twist. This insures a longer life of operation of the universal joint 30.

Referring to Figures 7 and 8 there is shown another embodiment of the present invention. The universal joint 130 comprises a first, second, third and fourth torsion arms 132, 134, 136 and 138 respectively. As previously discussed, the first and third torsion arms 132 and 136 may be a unitary member while

the second and fourth torsion arms 134 and 138 may also be a unitary member. The joint 130 further comprises a clamping means 142 which is comprises of four clamp pieces 144a, 144b, 144c and 144d. Each of the clamp pieces 144 has a flared portion 159 near the periphery 160 where the arms extend from the means 142. Each clamp piece 144 is between two immediately adjacent torsion arms and may be welded or suitably fastened to the adjacent torsion arms.

Referring to Figures 9 and 10 there is shown yet another embodiment of the universal joint of the present invention. The universal joint 230 comprises a first, second, third and fourth torsion arms 232, 234, 236 and 238 respectively. A pair of clamping means 242 and 244 are on opposite sides of the plane defined by the torsion arms 232, 234, 236 and 238. Each of the clampfng means is characterized by a flared portion 259 near the periphery 260. A screw 243 fastens the clamping means with the torsion arms therebetween.

In Figure 11 there is shown another embodiment of the present invention. The universal joint 330 shown in Figure 11 comprfses four torsion arms and clamping means that are exactly like that shown in Figure 2 except the torsion arms 332, 334, 336 and 338 are not exactly coplanar with one another. However, the torsion arms do form a substantially planar member. The angle of deviation O and Ø from the plane of the universal joint 330 is small. Typically, it is on the order of less than 15.. Such a joint may be useful for coupling connections where additional clearance is required at the intersection of the two torsion bars, or where it is desired to provide a softer spring rate where peripheral space is restricted.

Figure 12 shows still another embodiment of the universal joint 430 of the present invention. In this embodiment the first and third torsion arms 432

and 436 are not perpendicular to the second and fourth torsion arms 434 and 438. In this embodiment the joint 430 is stiffer along the axis 412 than along the axis 410. Thus, variation in the degree of stiffness of flexibility may be varied along various axis by changing the angular displacement between adjacent torsion bars.

Referring to Figure 13, there is shown one application of the universal joint 30 of the present invention. In this example, the first and third bridges, 62 and 66, are connected to a seat portion 70 of a chair while the second and fourth bridges 64 and 68 are connected to a base portion 72 of a chair. A chair having such a mechanical linkage between the seat portion 70 and the base portion 72 would have 3 degrees of freedom and in addition would be easier to construct than the pivotal adjustment as disclosed in U.S. Patent No. 4,185,803. Of course, there are many applications of the universal joint 30 of the present invention other than use in a chair or a seat. Other examples include the use of the joint as an engine mount, as a shock and vibration isolator for masts, towers, and cranes as well as for coupling between two rotatable shafts, such as drive shafts.

Claims

1. A universal joint suspension element comprising:

a substantially planar member having four torsion arms extending from a central location, said arms forming a pattern of two lineal bars intersecting one another;

means for securely fastening said arms at said location, with said arms extending from said means; and

said means characterized by a flared portion in the periphery of said means near where said arms extend from said means.

2. A mechanical linkage element for connection between a first moveable body and a second moveable body, wherein said element comprises:

a substantially planar member having four torsion arms, extending from a central point, said arms forming a pattern of two lineal bars intersecting one another;

one of said arms connected to said first body;

another of said arms connected to said second body;

means for securely fastening said arms at said point, with said arms extending from said means; and

said means characterized by a flared portion in the periphery of said means near where said arms extend from said means.

3. The element of Claim 1 or 2 wherein said means comprises a pair of clamping means, one on each side of the member; each of said clamping means has a plurality of grooves therein such that the arms of said member are secured in said grooves and each of said grooves flared outward near the periphery of the clamping means.

4. The element of Claim 3 further comprising fastening means for fastening the clampfng means and the member together.

5. The element of Claim 4 wherein each of said clamping means is a clamp.

6. The element of Claim 5 wherein said clamps are identical in size and shape.

7. The element of Claim 6 wherein each of said clamp is substantially cylindrically shaped.

8. The element of Claim 1 or 2 wherein said means comprises four clamping means, each clamping means between two immediately adjacent torsion arms; each clamping means characterized by a flared portion in the periphery near where said arms extend from said means.

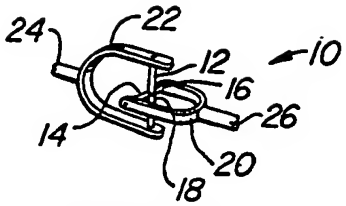
9. The element of Claim 8 further comprising fastening means for fastening said clamping means to said torsion arms.

10. The element of Claims 1 or 2 wherein said arms are all identical in size and shape.

11. The element of Claim 10 wherein each of said arms is substantially in the shape of a rectangular solid.

12. The element of Claim 1 or 2 wherein said lineal bars are substantially perpendicular to one another.

13. The element of Claim 2 wherein said first body is a base or support column portion of a chair and said second body is a seat portion of a chair.



PRIOR ART

FIG. 1.

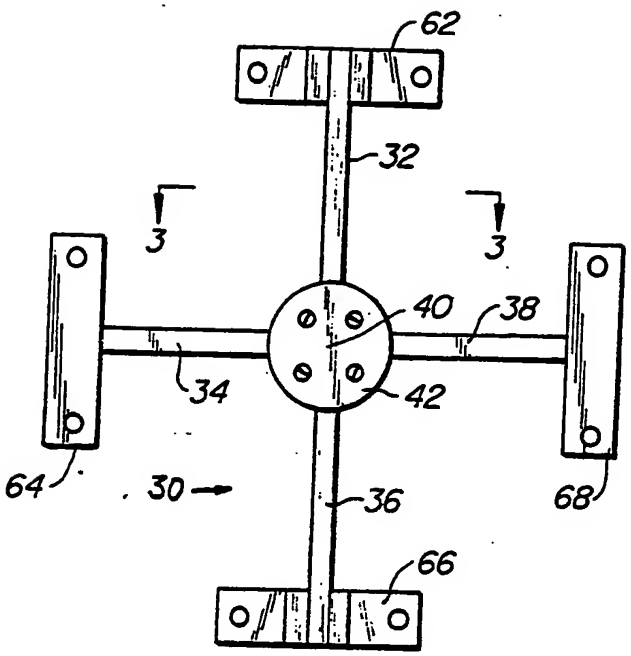


FIG. 2.

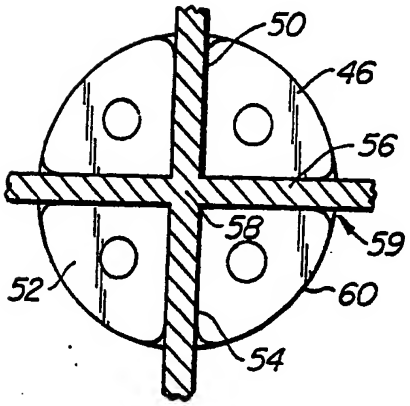


FIG. 4.

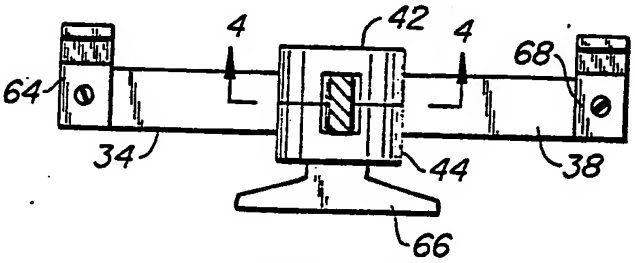


FIG. 3.

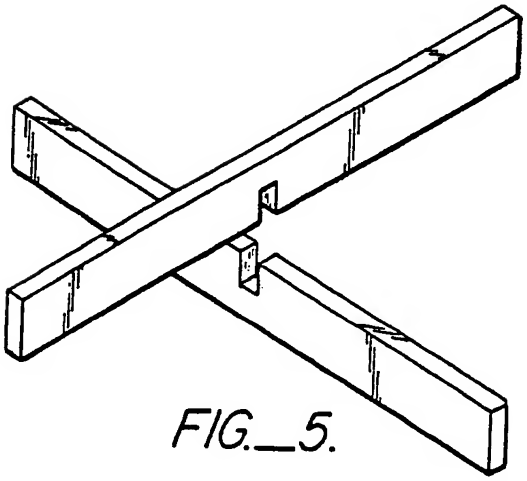


FIG. 5.

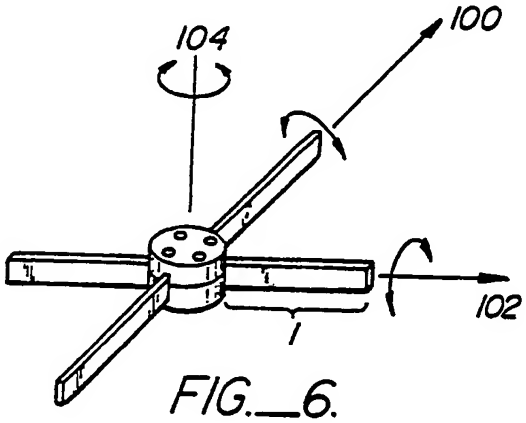


FIG. 6.

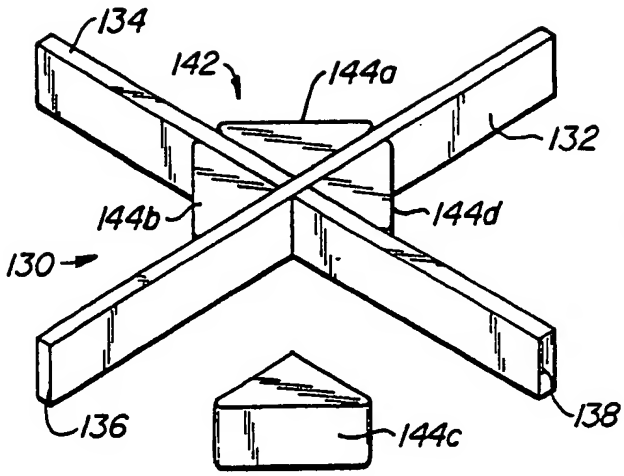


FIG. 7.

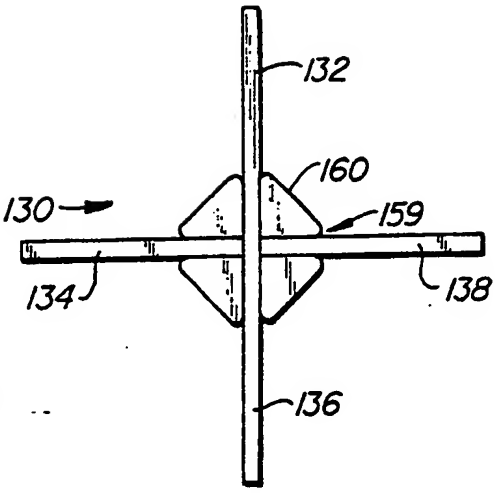


FIG. 8.

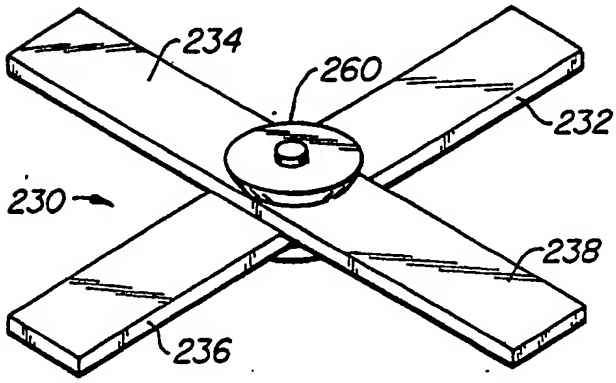


FIG. 9.

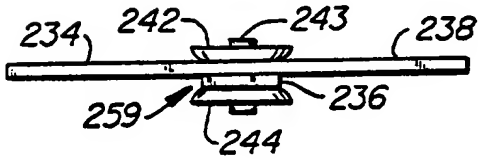


FIG. 10.

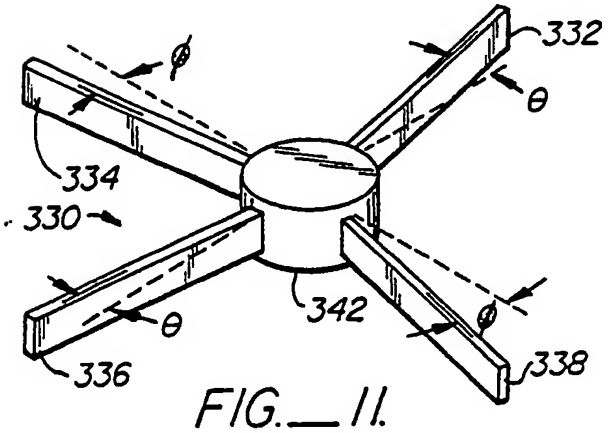


FIG. 11.

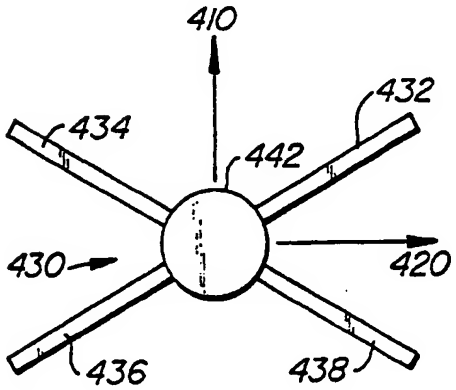


FIG. 12.

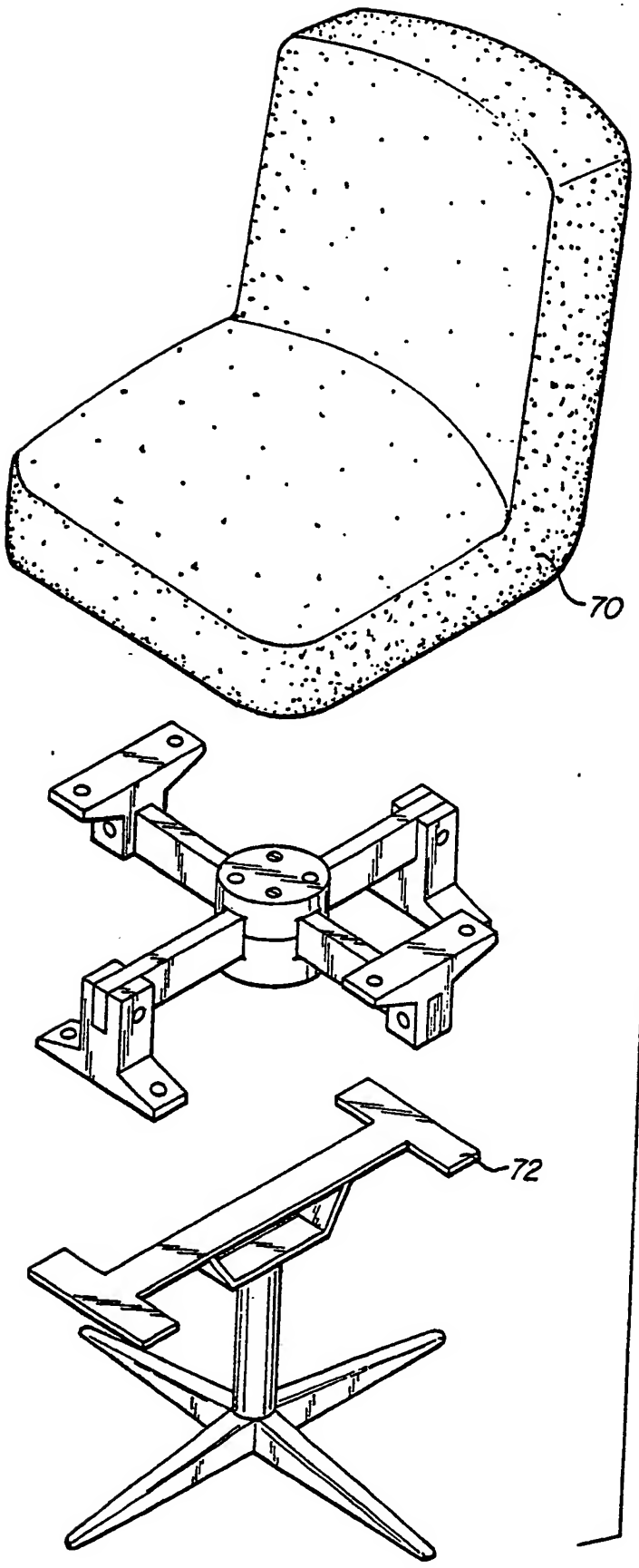


FIG._13.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US81/01522

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INt. Cl.[3] F16M 13/00, A47C 3/00, B60N 1/02
US. Cl. 248/608. 297/302

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	248/608, 188.7; 297/302,303; 267/133,154,160 403/347, 346,396

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US,A 4,236,752 Published 2 December 1980	1 to 13
A	US,A 3,544,159 Published 1 December 1970	1-13
A	US,A 3,188,033 Published 8 June 1965	1-13
A	US,A 2,119,946 Published 7 June 1938	1-13
A	US,A 3,895,771 Published 22 July 1975	1-13
A	US,A 4,185,803 Published 29 January 1980	1-13
A	GB,A 1,265,035 Published 1 March 1972	1-13
A	GB,A 683,677 Published 3 December 1952	1-13

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"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
10 February 1982	19 FEB 1982
International Searching Authority [1]	**Signature of Authorized Officer** [20]
ISA/US	J. Franklin Foss Primary Examiner Art Unit 339

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